Subsurface Mass Computation

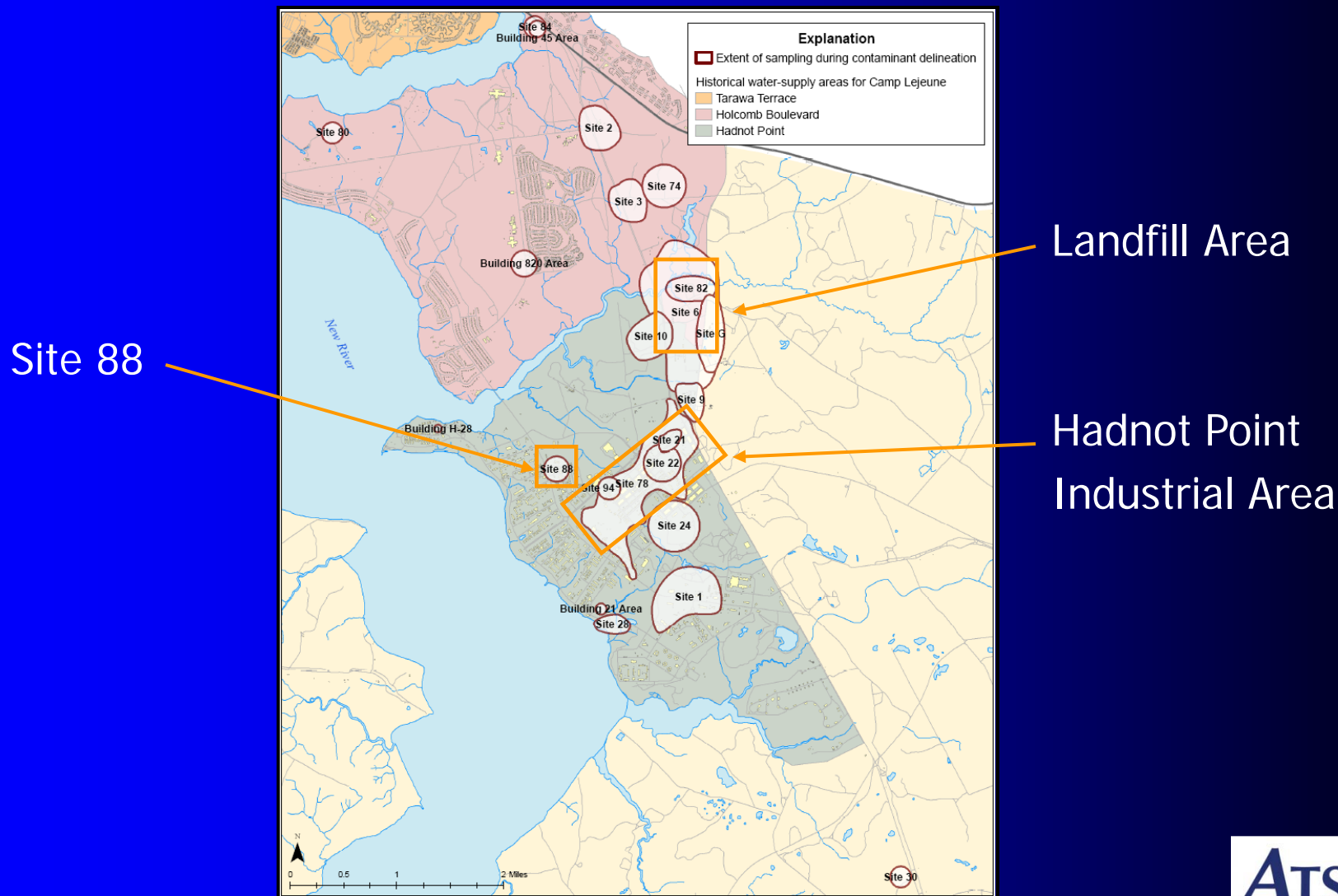## *Hadnot Point and Vicinity, Camp Lejeune, North Carolina*

Barbara Anderson, P.E., MSEnvE

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Overview

- Site locations, contaminant statistics

- Mass computation – purpose, scope, methods

- Illustration of mass computation for TCE

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Site locations within the Study Area

Landfill Area

Site 88

Hadnot Point
Industrial Area

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Groundwater Contaminant Data

1984 – 2004 ..... Timeframe of available contaminant data

868 ..... Wells, boreholes, and hydropunch locations

2,420 ..... Groundwater samples analyzed for PCE, TCE, DCE, Vinyl Chloride

2,611 ..... Groundwater samples analyzed for BTEX

Maximum detected concentrations in groundwater, in µg/L

170,000 ..... PCE

180,000 ..... TCE

36,000 ..... Benzene

* Based on contaminant data that ATSDR had received and reviewed through February 2009.

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# Computation of Contaminant Mass at Hadnot Point and Vicinity

Purpose

- Calibration of fate and transport model (provides starting point and lower limit for mass loading)
- Assessment of plume stability over time
- Comparison to other, similar sites

Scope

- PCE, TCE, and Benzene
- Dissolved phase contaminant mass (some unsaturated zone and free product areas considered)
- Multiple areas across the study site

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General Methodology
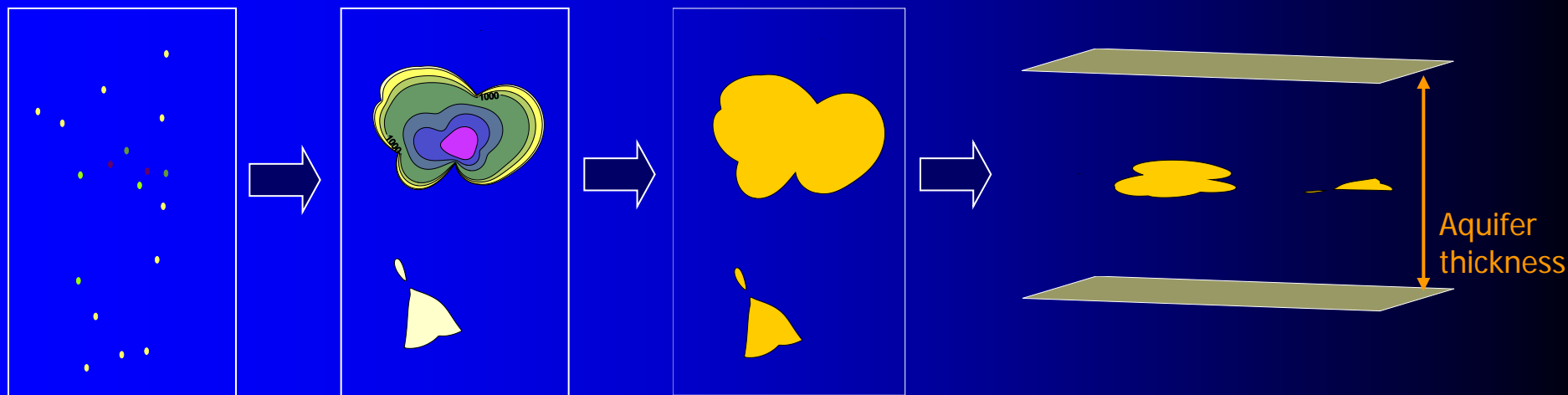
(1)

Select and prepare contaminant data sets (point data)

(2)

Develop two-dimensional (horizontal) concentration grids/distributions using interpolation techniques
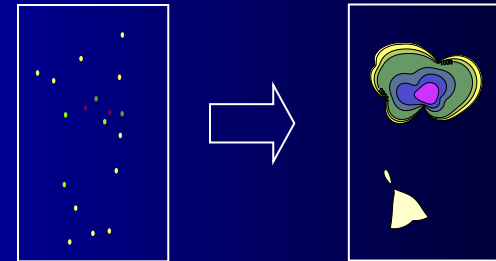
(3)

Calculate average contaminant concentration across two-dimensional horizontal plume

(4)

Contaminant mass = Ave. conc. across horiz. plume x

Planar area of plume x Aquifer thickness x

Aquifer porosity x

Conversion factors

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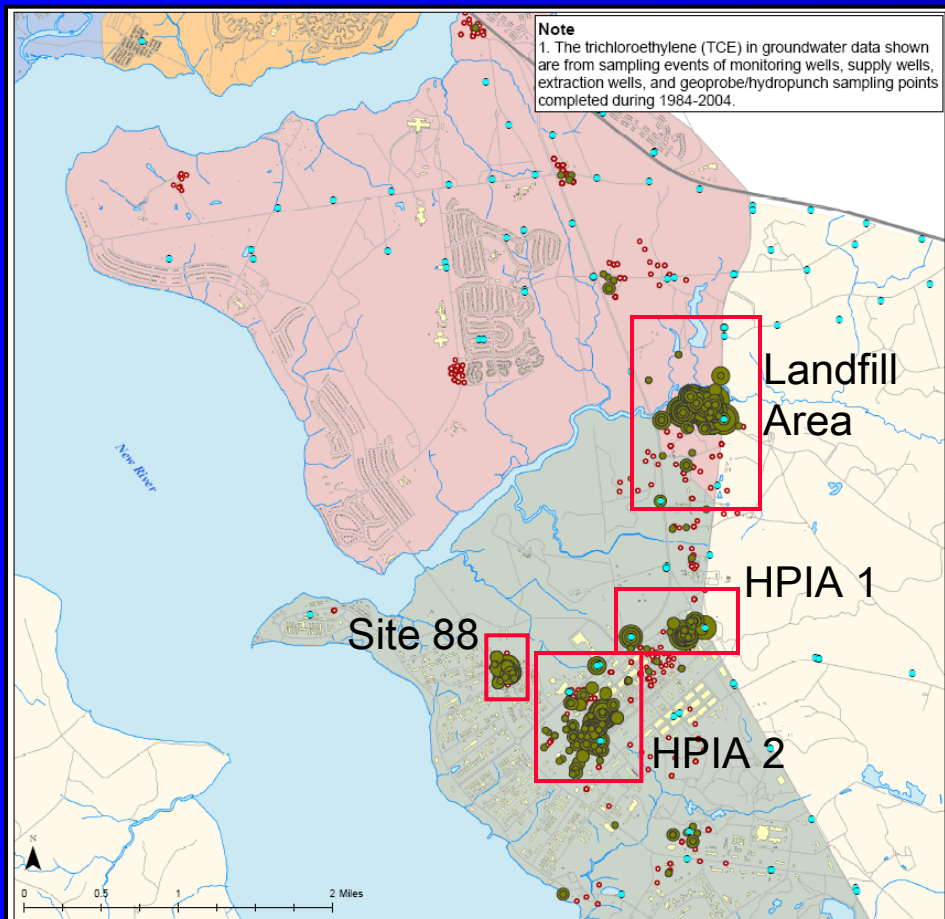
Data Preparation and Interpolation

Data preparation

- Select data sets by considering
  - Horizontal distribution of contaminants (identify sites within the study area)
  - Vertical distribution (sample altitudes)
  - Temporal distribution (sample collection dates)

- Multiple detections at same location: using average vs. maximum values

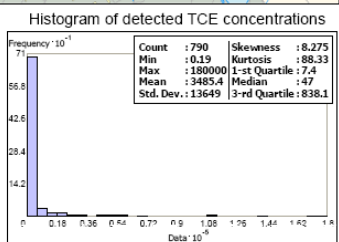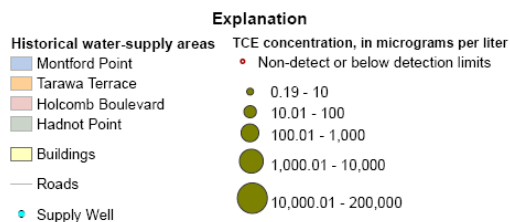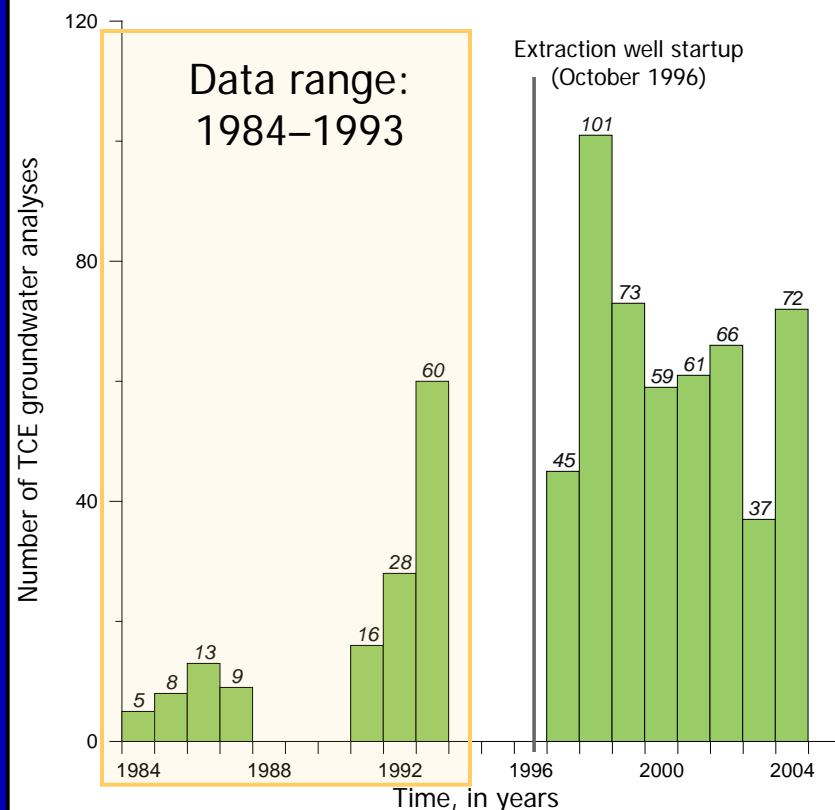- Nondetects and censored nondetects: set to zero

Interpolation

- Ordinary kriging using standard, default assumptions within Surfer software
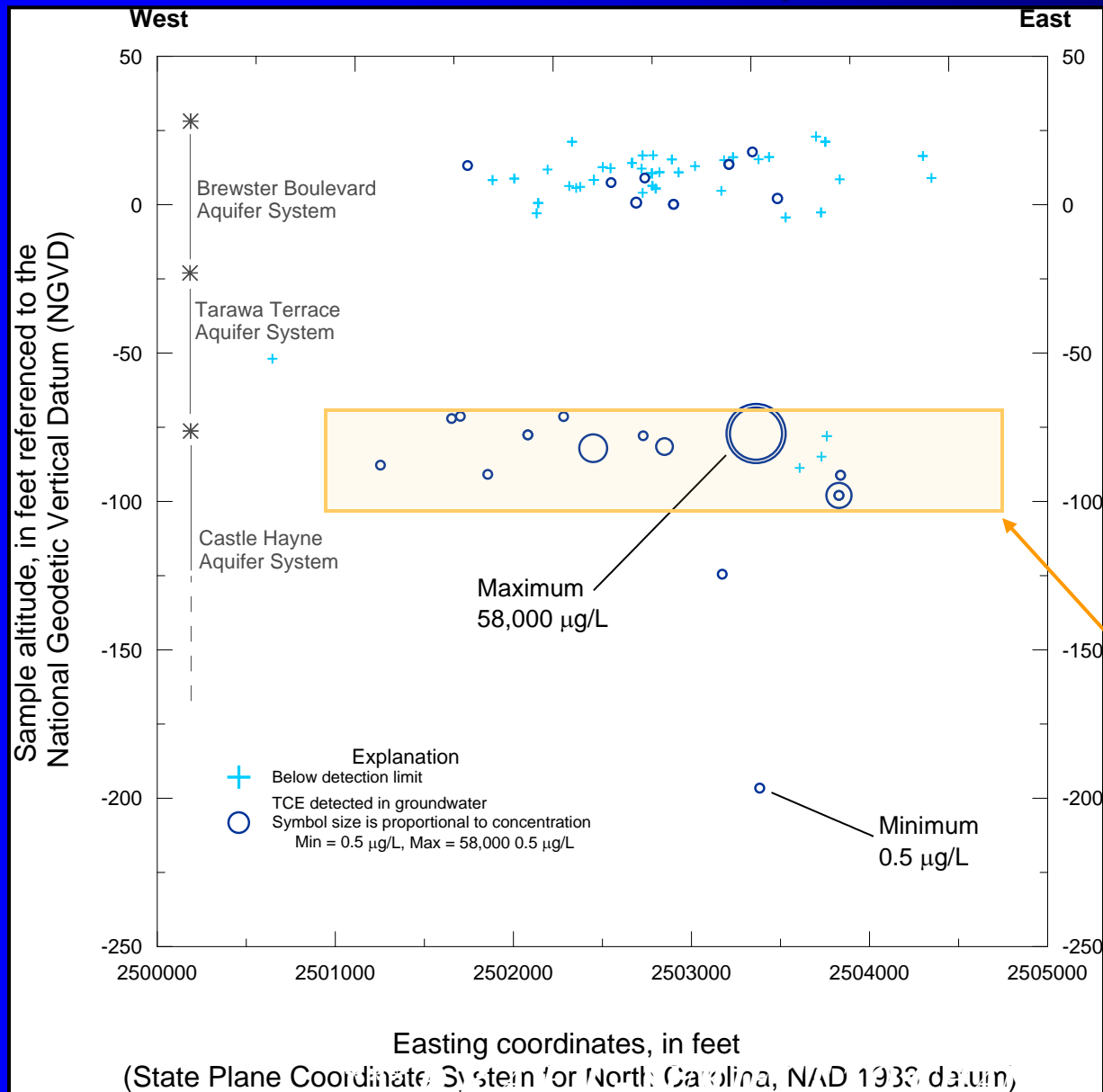
- 10 foot x 10 foot grid cell size

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Illustration: TCE Mass Computation

Vertical distribution of TCE, Landfill Area, 1984–1993

TCE Concentrations in the Lower Aquifer (UCHRBU) Landfill Area, 1984–1993
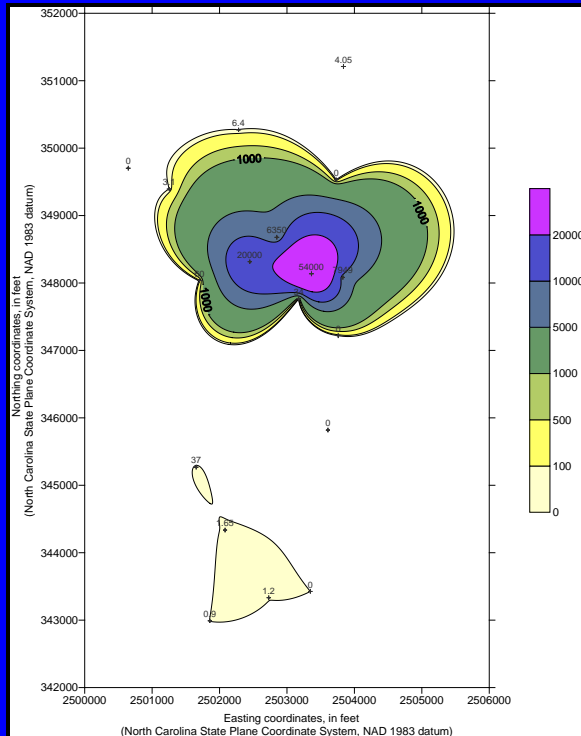
- Use Surfer's grid volume report utility to obtain:
  - Grid "volume", in µg/L - ft^2 (essentially the sum of the area-weighted concentration for each grid cell)
  - Planar area of the plume, in ft^2

- Average TCE concentration for the plume, in µg /L = Grid "volume" / Planar area of the plume

  (*Ricker 2008*)

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Ricker JA. A Practical Method to Evaluate Ground Water Contaminant Plume Stability. Ground Water Monitoring & Remediation. 2008; 28(40):85–94.
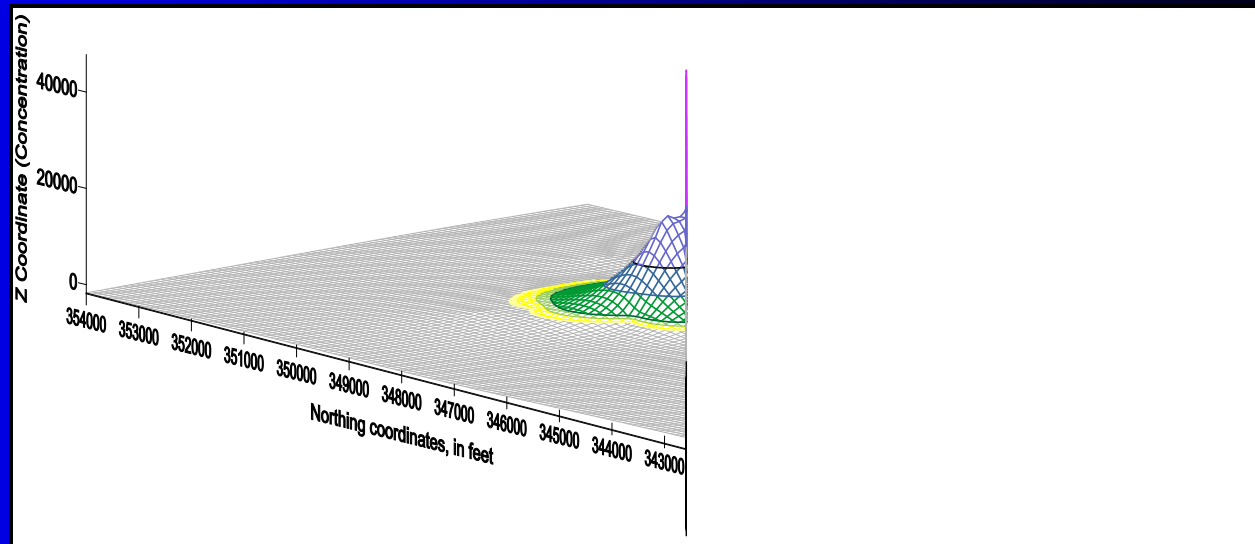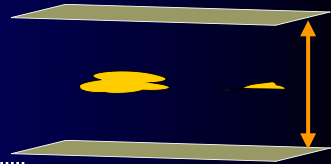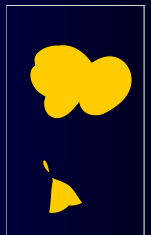
TCE Concentrations in the Lower Aquifer (UCHRBU)
Landfill Area, 1984–1993

TCE mass [grams] = TCE average concentration [µg/L] x Planar area [ft^2] x Aquifer thickness [ft] x Aquifer porosity x 28.31685 [L/ft^3] x 0.000001 [g/µg]

Planar area of the plume	11,862,377 ft^2	Calculated using Surfer utility
Average TCE concentration	4,821 µg/L	Calculated as "volume" of concentration grid divided by planar area of plume (both values obtained using Surfer utility)
Aquifer thickness	22 ft^2	<u>Average</u> estimated thickness of Upper Castle Hayne –River Bend Unit (UCHRBU) in the Landfill Area
Aquifer effective porosity	0.20	Estimated porosities for UCHRBU from site-specific data
Aquifer total porosity	0.40	
Conversion factors	28.31685	Liters per cubic foot
	1 x 10^{-6}	Grams per microgram
Dissolved phase TCE	**7,100,000 grams**	**1,300 gallons** (using effective porosity)
	14,000,000 grams	**2,600 gallons** (using total porosity)

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Questions?

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